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(54) An appliance for the mixing and/or transfer of a substance.

(57) An appliance for the mixing and/or transfer of a substance, particularly a medical solution. The appliance comprises a first unit (2), with one or more connection apertures (10, 14) for connection to external containers (12, 16) and a second unit(4) which is connected or connectable to a substance container (6). Devices (44, 34) are provided on said first and second units (2, 4) for connection of the two units to each other. An automatic shut-off valve (8) is fitted in at least one of the connection apertures in the first unit (2). The valve (8) keeps the connection aperture (10) closed in an inactive position, whilst it is opened and kept open by the container (12) connected to one of the connection apertures (10.

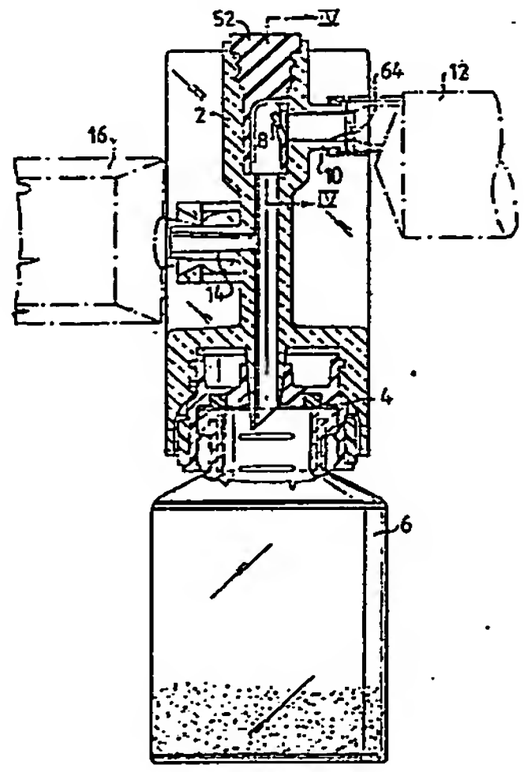

FIG.1

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Description

An appliance for the mixing and/or transfer of a substance

Technical field

This invention relates to an appliance for the mixing and/or transfer of a substance, in particular a medical solution. The appliance comprises a first unit, provided with one or more connection apertures for connection to an external container, and a second unit connected to, or connectable to, a container for the substance. Devices are fitted to the first and second units for connection of both units to each other.

Background art

Certain medical preparations used in the medical care area expose both personnel and patients to considerable risks when the preparations are handled. This applies primarily to cytostatic or cytotoxic drugs which are used to treat cancer patients, but also other substances such as antibiotics which when handled can give negative reactions in personnel and patients due to the allergenic properties of the preparation. An increased awareness of personnel and hospital management of these risks has resulted in systems which will reduce the risk in the handling of these preparations.

Sterile medicaments intended for injection or infusion, e.g. cytostatic, are normally supplied in powder form in glas bottles with tight-fitting seals. When used, the powder is to be mixed with a liquid, such as sterile water, saline solution or some other solution. This liquid is preferably supplied in a glass ampoule, and mixing of the liquid and powder takes place by means of the liquid in the glass ampoule first being drawn into a hypodermic syringe, after which the liquid is injected into the glass bottle by the syringe penetrating the seal of the glass bottle. The bottle is shaken so that the powder and liquid mix, after which the mixture is drawn back into the hypodermic syringe. Unless additional safety precautions are taken, such handling entails major risks for the personnel involved. Spillage in the form of drippings and drops is difficult to avoid, at the same time as contamination of the surrounding air occurs through the formation of positive pressure in the glass bottle which leads to the leakage of aerosol mist to the surroundings.

Personnel who treat patients with cytostatic and other toxic substances are exposed to the risk of inhaling, or otherwise being affected by direct contact with, these substances. The increased awareness of these risks has resulted in that the handling of these substances, i.e. the mixing of powder and liquid, and the filling of hypodermic syringes, today takes place in special hoods. Handling in these hoods is complicated and inconvenient for the personnel. In addition it necessitates the centralized treatment of patients, since such expensive equipment can only be justified in central medical care units.

In order to overcome the problems described above, systems of a disposable type have been designed for the mixing and transfer of medical preparations.

The published Swedish Patent 434700 discloses such a disposable appliance, intended for the prevention of air contamination in the transfer of a substance from a vessel to a hypodermic syringe. The appliance comprises a first part, in which a needle is enclosed and which is also fitted with a membrane that can be pierced by the needle, as well as with a connection aperture, in which a bung to a hypodermic syringe is intended to be connected. Further, the appliance comprises a second part, which is also fitted with a penetrable membrane. The first and second parts are detachably connectable to each other, whereby both membranes in the connected position bear on each other. The second part is designed so that it can be snapped onto a sealed bottle containing the dry substance. When the first part is compressed, which is possible by virtue of it having flexible side walls, the needle penetrates both membranes as well as the seal of the bottle so that a protected connection is formed between the syringe and the bottle. Mixing and transfer take place through the liquid being drawn into a syringe which is thereafter connected to the connection aperture of the first part. The liquid is pressed down into the bottle and is mixed with the powder, after which the solution formed is drawn back into the syringe.

Another design of a disposable type is disclosed in WO 85/04097. This application shows an appliance where the bottle containing the dry substance is enclosed in a larger, flexible, surrounding and sealed container. The hollow needle of a hypodermic syringe penetrates the container and bottle seals, and liquid is injected into the bottle from the syringe, at which positive pressure forms in the bottle. The positive pressure in the bottle is equalized by permitting the gas to escape into the surrounding container. Instead of a normal penetrable seal, the container can be fitted with a multi-channel valve, which is adjustable by turning the body of the valve manually. The different positions of the valve body open and close connections between the various connections in the valve seat. These connections are intended for the connection of a hypodermic syringe as well as various tubes that are attached to external appliances. A hollow needle connected to the central aperture of the valve body penetrates the seal of the bottle, whereby a connection between the bottle and the valve seat arises.

A major disadvantage of both systems described is that they are complicated to use, and for safe and proper handling require a large number of actions. The risk of an erroneous action thus increases, which results in decreased safety in the system. Another disadvantage is that both systems are complicated and have a great number of details in their structural design, which gives a high production cost which is especially troublesome for medical care equipment intended for single use. The components of the known systems are difficult to keep

sterile during handling. Patients who are treated with cytostatic substances often have poor immune defence, which is why extra-high requirements concerning sterility are imposed on products that are to be used in this context.

Basic idea of the invention

The aim of this invention is to solve the above-mentioned problems by means of a system which contains a small number of simply-formed parts, a system which can be handled in one single operation and which is adapted for connection to standard accessories.

The present invention is characterized by the fact that an automatic shut-off valve is incorporated in at least one connection aperture in the first unit. In an inactive position, this valve keeps the connection aperture closed, and is opened, and kept open by, a container connected in the connection aperture.

Further advantageous characteristics are apparent from the following description of the working example and by dependent claims.

The design according to the invention meets the essential requirements that are made on a well-functioning and safe system for the mixing and transfer of a medical substance, e.g. cytostatics, viz:

a) The system shall be sealed, no leakage shall be able to occur.

b) The system shall be inexpensive so that it is suitable for disposable use, even for medical products less expensive than cytostatic drugs, such as antibiotics, anaesthetics etc.

c) The use of the system shall be simple and uncomplicated, and the risk of erroneous action minimized.

d) Emptying of the system shall be almost total, owing to the fact that cytostatics are a comparatively expensive product.

e) Incorporated units shall be able to be kept sterile in handling.

f) Standardized accessories shall be simple and be able to be connected safely to the system.

The present invention creates the possibility of decentralizing the handling of pharmaceutical substances from the central medical care institutions to the local medical care units. Decentralization of this type leads to major benefits for both patients and medical care administrations.

The present invention is principally intended for the mixing of a substance in powder form with a liquid in order to form a solution which is transferred to a hypodermic syringe. However, the appliance can also be used for mixing two or more liquids or gases and for only transferring a liquid or gas to an external container. The connection apertures that shall not be used are in such cases sealed, preferably with a plug that is specially adapted to, and seals, such apertures.

All connections incorporated in the appliance, such as shut-off valves, external container connections, bottle seals and devices for connection of the first and second units to each other, are designed so that they seal off gas at a certain positive or negative pressure, which in certain cases occurs in the drying or mixing process. Furthermore, positive pressure can be created by protective gas (nitrogen) being added to the container holding the ready-mixed solution, with the aim of making it possible to store the solution during a shorter period of time.

Brief description of appended drawings

An embodiment of the present invention, and modification of the same, are described in closer detail below, with reference to appended drawings, where

- Figure 1 shows an axial section through one embodiment of the invention in a position where the first and second units are connected to eath other
- Figure 2 a-b show an axial section through the second unit, or sealing unit, in two different positions on the mouth of the substance container
- Figure 3 shows an axial section through the first unit, or mixing unit
- Figure 4 shows an enlarged section along line IV-IV in Figure 1
- Figure 5 shows the appliance as per Figure 1 seen from above and enlarged
- Figure 6a and 6b show an axial cross section view and side view of an alternative design of the first unit, or mixing unit
- Figure 7 shows an axial section through a second embodiment of the valve plug in the mixing unit
- Figure 8a shows an axial section through a third embodiment of the valve plug in the mixing unit, and Figure 8b shows a section along line VIIIb-VIIb in Figure 8a
- Figure 9 shows an axial section through a fourth embodiment of the valve plug
- Figure 10 shows the appliance as per Figure 1 in use

Detailed description of presented ebodiments of the invention

From Figure 1 it can be seen that the appliance according to the present invention consists of a first unit which comprises a mixing unit (2) and a second unit which comprises a sealing unit (4) to a substance container (6), particularly a glass bottle, which contains a freeze-dried medical product, e.g. cytostatic. A valve plug (52) is fitted at one end of the mixing unit, and is designed to create a shut-off valve (8) to a first connection aperture (10) intended for the connection of a hypodermic syringe (12). A second connection aperture (14) is provided on the mixing unit for connection of a flexible liquid container (16), e.g. Polyamp^{R}.

Figures 2a and 2b show the sealing unit (4) in two different positions on the glass bottle (6). In Figure 2a, the seal is in a first stop position on the glass bottle where the flange (18) of the bottle is kept in place between four upper and four lower lips (20) on the inside of the lower part of the sealing unit. In this closing position, the cytostatic in the glass bottle can be freeze dried in a traditional process in which steam passes through a number of slits (22) in the lower part of the seal. On completion of drying, the

sealing unit is depressed to the position shown in Figure 2b, whereby the sealing ring (24) fits tightly against the upper edge of the glass bottle (6) and the upper lips (20) fit in beneath the flange (18) of the glass bottle. A locking ring (26) is pressed past the projection (28) to the final locking position which is shown in Figure 2b. The glass bottle (6) is now safely sealed in that the flange (18) is locked by the upper lips (20) which are secured in position by the locking ring (26), which in turn is secured by the projection (28).

The sealing unit (4) also has a predominantly cylindrical neck (30) provided with two external bayonet lips (32) for interaction with thread-shaped grooves in the mixing unit (2). The base of a cylindrical aperture (34) is designed with an internal penetrable membrane (36) and this aperture is kept sterile before use in that the connection unit (4) is covered by either a removable, welded wafer (38) made of aluminium, plastic laminate or some other suitable material or an injection moulded cap. Unlike earlier mechanical seals, the welded seal on the wafer (38) guarantees a sterile aperture for connection to the mixing unit (2). The connection unit is made of a suitable plastic material, preferably polypropylene.

The mixing unit (2), which is shown in Figure 3, is made of a transparent plastic material such as polycarbonate, which makes it possible for the user to check that the system is air-tight and that virtually complete emptying of the appliance has taken place. Before use the mixing unit is preferably sterile packed in a blisterpack.

The mixing unit (2) consists of a lower section in the form of a cylindrical housing (40), in which internal thread-shaped grooves (42) are designed for interaction with the bayonet lips (32) of the connection unit. The thread-shaped grooves may be designed with wedge-shaped steps (not shown) for locking of the bayonet lips (32) in the threaded position. Inside the housing (40) and protected by it from movement, there is a centrally-located open, tube-shaped spike (44), which is cut diagonally so that a point (46) or a conically shaped tip is formed at the external end. The spike may also be fitted with an external sealing lip (not shown in the figures). The tube-shaped spike (44) is combined with a duct (48) which passes through the mixing unit (2) and widens in the section for the first connection aperture. In the widened section (50), a valve plug (52) is pressed in to form a sealed contact against the walls of the widened duct. The valve plug (52) should preferably be provided with sealing grooves (54) to guarantee a complete seal. The material used for the plug consists of a medically adapted rubber material which shall be sealed against migration and be hygienic. The external section (56) of the valve plug is solid, and the inner part changes into the shape of a cylindrical tube (58). At the connection between the two parts, an aperture (60) (see also Figure 4) is provided in the cylinder wall.

A first connection aperture (10) is provided in the mixing unit, which opens into the widened duct (50) in the immediate vicinity of the valve aperture (60). The mouth of the connection (10) is in a first position closed by a valve tongue (62), and in a second position, which is shown in Figure 1, open in that the valve tongue (62) is bent to one side. The connection aperture (10) is slightly conical in order to be able to be connected in a sealed manner to the Luer cone (64) of a hypodermic syringe (12) (see Figure 1). The outer point of the Luer cone (64) penetrates to a certain extent into the widened duct (50) when the Luer cone is fully inserted into the connection aperture (10). The valve tongue (62) below the valve aperture (60) is thereby bent to one side so that a connection is made between the duct (48) of the mixing unit and the first connection aperture (10), and thus the hypodermic syringe. The connection aperture is externally provided with two opposing locking lips (66), referred to as a Luer lock. The locking lips are intended to interact with corresponding grooves in the hypodermic syringe for axial locking of the syringe in the inserted position.

The mixing unit (2) is also provided with a second connection aperture (14) which opens into the duct (48) and which externally has the shape of a Luer cone. The second connection aperture (14) is intended for connection to a flexible liquid container (16) (see Figure 1), e.g. Polyamp® with a female Luer aperture. In order to lock the liquid container (16) axially in a connected position, two gripping devices (68) are provided, which grasp the opening edge of the liquid container (16) (see Figure 1). Figure 5 shows how gripping tongues (70) on each side of the connection apertures (10, 14) grip them so that the tongues (70) constitute grip protection for these apertures and thereby prevent contamination during handling.

An alternative design of the mixing unit (2) is shown in Figures 6a and 6b. Here the mixing unit (2) is designed with the first (10) and the second connection apertures (14) arranged opposite each other at the same level and connected to each other by a through duct. A valve plug (52) is fitted and designed largely as in Figure 4 with the exception of a further recess (82) in the cylindrical tube part (58), which connects the duct (48) with the inner section of the valve plug. A tube-shaped spike (44) is connected to the centre of the duct and is surrounded by a cylindrical housing (40) in the same way as shown in Figures 1 and 3. Gripping tongues (70) protect the two connection apertures (10, 14) against touch.

An alternative design of the valve plug is shown in Figure 7. Here the valve plug (52) is designed as an upwardly open cylindrical container with a rounded bottom, the external contours of which seal and bear against the inner walls of the widened duct (50). In order to ensure a complete seal in the outer part of the plug, a tensioning device (72) is provided to press the cylinder walls against the walls of the duct in this part of the plug. When a Luer cone (64) (see Figure 1) is connected to the first connection aperture (10), the elastic wall is pressed in so that a connection with the duct (48) is opened on the outside of the valve plug (52).

The mixing unit (2) which is shown in Figures 8a and 8b is designed with the first and second connection apertures (10, 14) arranged in the main

opposite each other. A homogeneous valve plug (52) is pressed into the widened duct (50). The inner part of the plug (52) has a rounded form which connects to the shape of the widened duct (50) (see Figure 8b). In this part of the valve plug a groove (74) is provided, which runs from the first connection aperture (10) via the duct (48) and to the second connection aperture (14). A corresponding lip (76) against the groove (74) is provided in the widened duct (50) between the first connection aperture (10) and the duct (48). The groove (74) thus creates an open connection between the duct (48) and the second connection aperture (14), whilst the lip (76) seals and bears against the groove (74) between the duct (48) and the first connection aperture (10), so that no connection between the duct (48) and the aperture (10) exists. When the syringe (12) is connected (see Figure 1), the Luer cone (64) presses against the homogeneous valve plug (52), so that groove (74) and lip (76) separate and a connection is formed.

Figure 9 shows a further alternative design of the valve plug (52), which here is provided with a closure bung (78, 80) adapted for each connection aperture (10, 14). The second open (in a normal position) connection aperture (14) is closed by the closure bung (78) when the Luer cone (64) of the syringe on connection opens the first connection apertue (10) by means of pressing the corresponding closure bung (80) out of the aperture.

Function of the invention

When the mixing system according to the present invention is to be used, see Figure 1, the wafer (38) is first removed from the sealing unit of the glass bottle (4), so that the cylindrical aperture (34) is exposed. The mixing unit (2) is taken out of the blisterpack with the help of grip tongues (70), which protect the connection apertures (10, 14) against touch. The flexible liquid container (Polyamp^{R}) (16) is thereafter opened and connected to the Luer cone at the second connection aperture (14) on the mixing unit (2), at which the gripping device (68) grips the edge of the opening on the liquid container (16) and locks it to the mixing unit (2). The sealing unit (4) is threaded onto the mixing unit (2), whereby the spike (44) enters the cylindrical aperture (34) of the sealing unit so that a sealing connection is formed between the parts before the point (46) of the spike penetrates the membrane (36).

When the sealing unit (4) and the mixing unit (2) are thoroughly screwed and possibly locked to each other, the liquid in the flexible liquid container (16) is pumped down into the glass bottle (6), where it is mixed with the powdery substance into a solution by means of the bottle being shaken.

The hypodermic syringe (12) is thereafter connected by means of the Luer cone (64) of the syringe entering the first connection aperture (10) and the syring being screwed fast to the external locking lips (66) of the connection. The outer end of the Luer cone in this position presses down the sealing valve tongue (62), so that a connection between the duct (48) and the syringe (12) is formed.

The entire assembled units is thereafter turned upside down to a position shown in Figure 10. In this position air is pumped out of the air-filled flexibel container (16), so that air flows up into the glass bottle (6), whereby a corresponding volume of the ready-mixed solution is pressed back to the flexible container (16). When there is approximately the same amount of liquid in the container (16) and the glass bottle (6), the inclination of the appliance is adjusted so that both liquid levels are the same. The solution can now be more or less completely drawn up into the hypodermic syringe (12), which can be checked through the transparent mixing unit (2).

When the syringe (12) is filled with solution and the mixing unit is thus empty, the syringe is screwed off the locking lips, whereby the valve tongue (62) in the mixing unit (2) again seals the connection aperture (10). The syringe can now be used for injection in a traditional way and the remaining assembled unit be destroyed at one go.

The best mode of carrying out the invention known at present is as described above.

In the case of an embodiment according to Figure 9, the function is somewhat different, since the valve plug (52) is designed so that when the syringe (12) is connected, and thus the first connection aperture (10) is open, the second connection aperture (14) is closed. The ready-mixed solution is therefore drawn from the glass bottle (6) directly into the hypodermic syringe (12).

Conceivable modifications of the invention

The invention is in no way restricted to the working examples described above, and several conceivable modifications are possible within the framework of the claims. The valve plug, for example, may have a cross section of various geometric forms such as circular, square, rectangual or oval. The number of connection apertures may vary from one upwards, according to the need to connect different containers. The sealing unit may instead be designed to be pressed onto the sealed glass bottle when the mixing process is to begin. A sealing lip may be provided in the cylindrical aperture instead of on the needle. The conical needle may instead be cylindrical, in which case the interacting opening in the sealing unit shall also have a corresponding cylindrical form. The substance container may consist of a plastic bottle, in which case the locking ring may be replaced by a sealing weld joint between the sealing unit and the plastic bottle.

Claims

1. An appliance for the mixture and/or transfer of a substance, particularly a medical solution for injection, comprising a first unit (2) with one or more connection apertures (10, 14) for connection to external containers (12, 16), a second unit (4) connected or connectable to a substance container (6), whereby devices (44, 34) are provided on said first and second units (2, 4) for connection of the two units to each other, characterized in that in at least one connection aperture (10) in the first unit (2) an

automatic shut-off valve (8) is fitted, which in an inactive position keeps the connection aperture (10) closed and which is opened and kept open by one in the connection apertures (10) connected container (12).

2. An appliance as claimed in claim 1, characterized in that a shut-off valve (8) consists of an elastic plug (52) fitted in one end of a through duct (48) in the first unit (2), whereby the sealing plug (52) bears against and closes off the connection aperture (10).

3. An appliance as claimed in claim 2, characterized in that on the container (12), preferably a hypodermic syringe, intended for connection to the connection aperture (10), a sealing Luer cone (64) is provided, whereby the point of said Luer cone in connected position presses down the elastic valve plug (52) to a position which opens a connection between the connection aperture (10) and the duct (48).

4. An appliance as claimed in claim 2, characterized in that the said device on the first unit (2), for connection to the second unit (4), contains a to the duct (48) connected hollow spike (44), the end of which is diagonally cut to form a point (46) or a sharp tip.

5. An appliance as claimed in claim 4, characterized in that the said device on the second unit (4) for connection to the first unit (2) contains one against the spike (44) sealing cylindrical aperture (34), which is sealed by a membrane (36) provided at the bottom of the aperture and on connection penetrable by the spike (44).

6. An appliance as claimed in claim 5, characterized in that means are provided to lock axially the first unit (2) to the second unit (4), whereby said means of the first unit (2) comprise a cylindrical housing (40) which surrounds the spike (44) and which is provided with internal thread-shaped grooves (42).

7. An appliance as claimed in claim 6, characterized in that the said means on the second unit (4) for axial locking to the first unit (2) comprise a cylindrical neck (30) which surrounds the cylindrical aperture (34) and which has an external diameter which is the same size as the internal diameter of the cylindrical housing (40) of the first unit, whereby two diametrically arranged, thread-shaped bayonet lips (32) are provided on the outside of the cylindrical neck (30) for interaction with the thread-shaped grooves (42) on the first unit (2).

8. An appliance as claimed in claim 7, characterized in that the cylindrical neck (30) before the connection to the first unit (2) is sealed by an aluminium wafer (38) welded fast on the neck (30).

9. An appliance as claimed in claim 2, characterized in that a second connection aperture (14) is arranged in contact with the duct (48) in the first unit(2), which aperture (14) is in the form of a Luer cone and is intended to be connected to a flexible container (16), preferably a liquid container.

10. An appliance as claimed in claim 9, characterized in that locking devices (66, 68) are provided on the connection apertures (10, 14) for axial locking of the connected containers (12, 16).

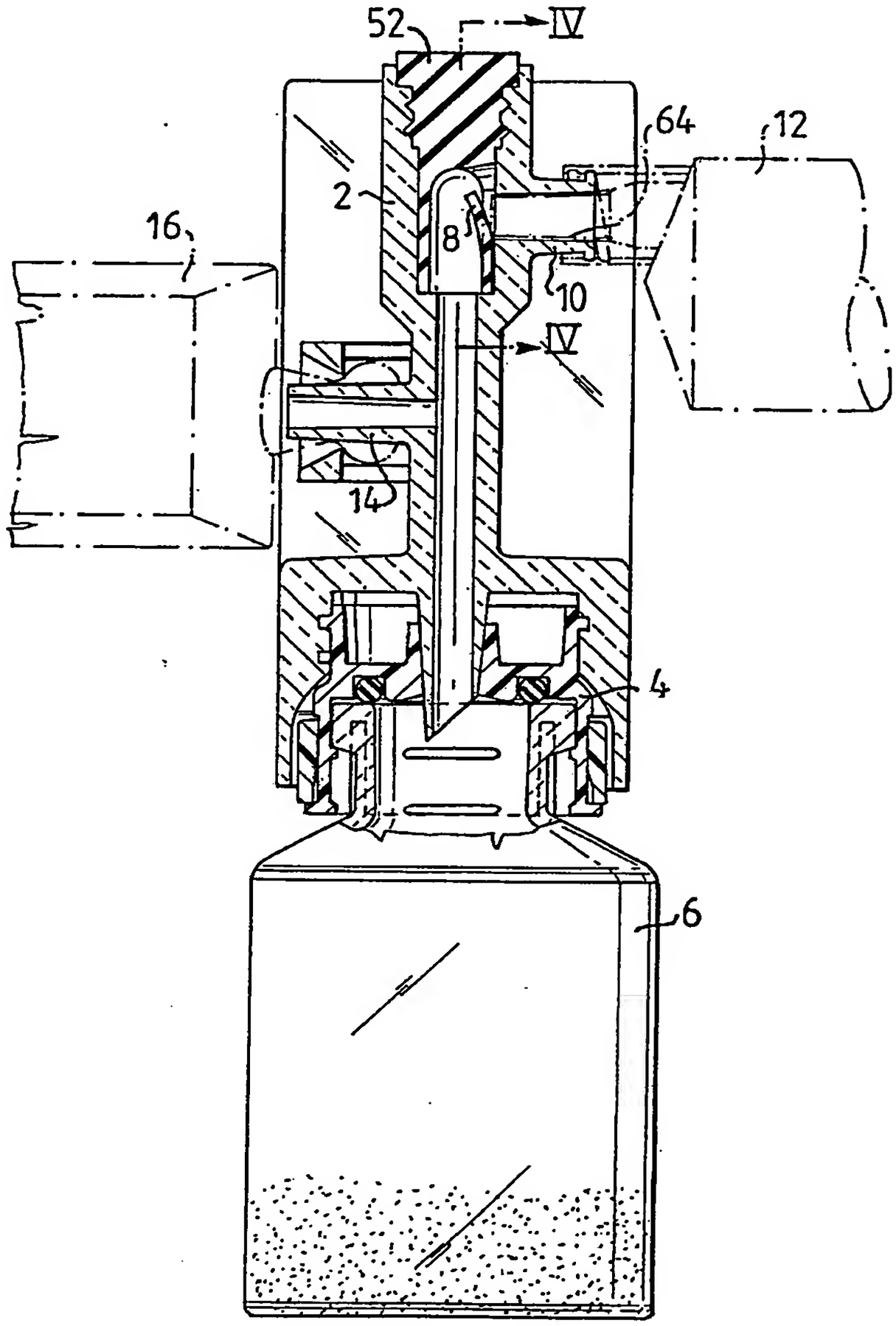


FIG.1

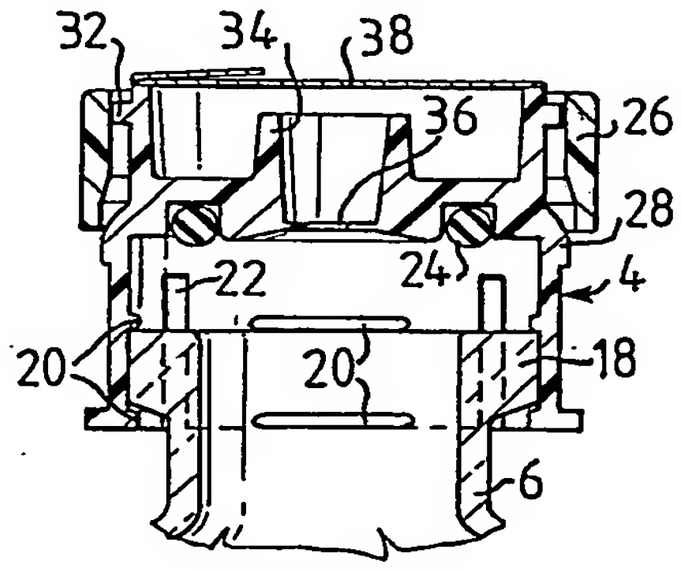


FIG. 2a

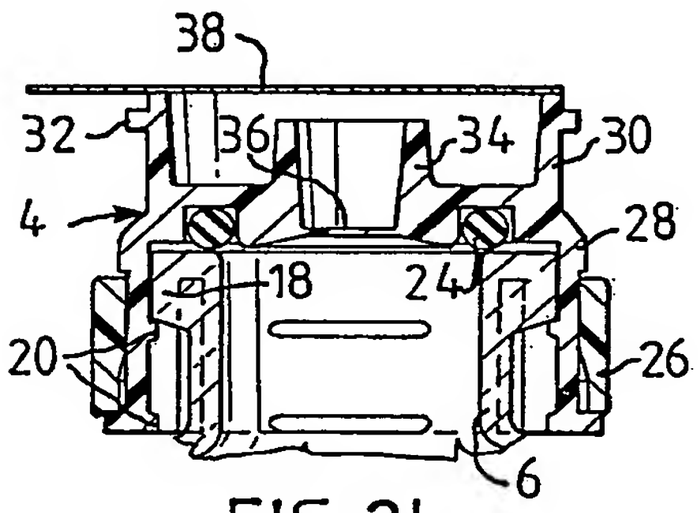


FIG. 2b

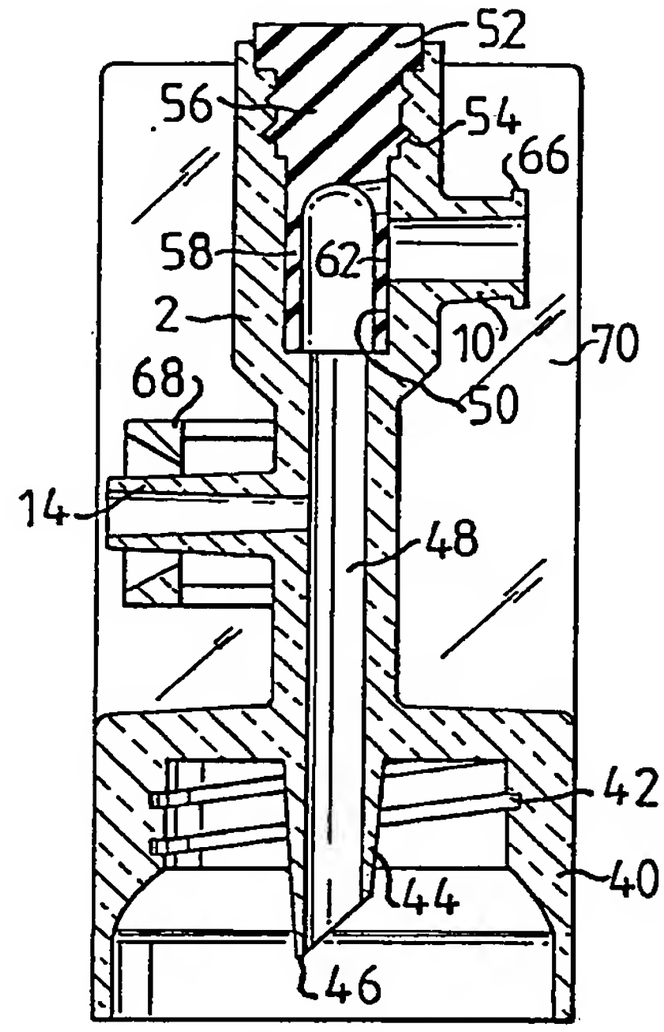


FIG. 3

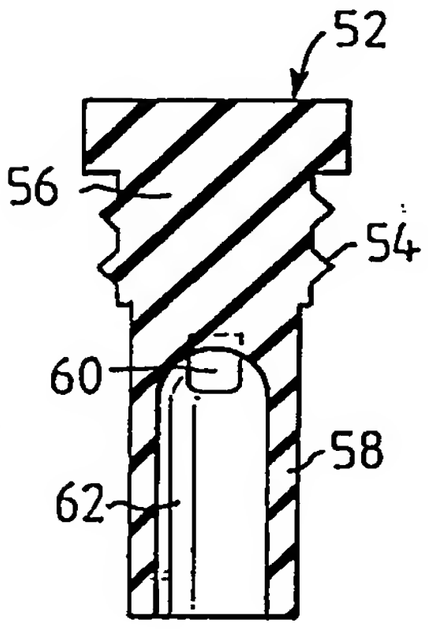


FIG. 4

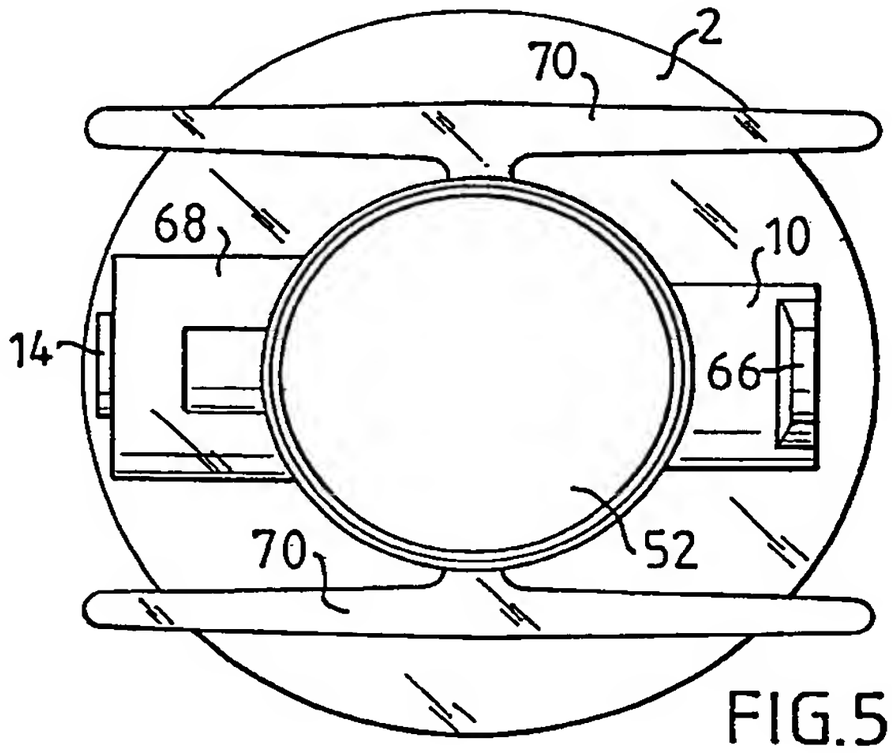


FIG. 5

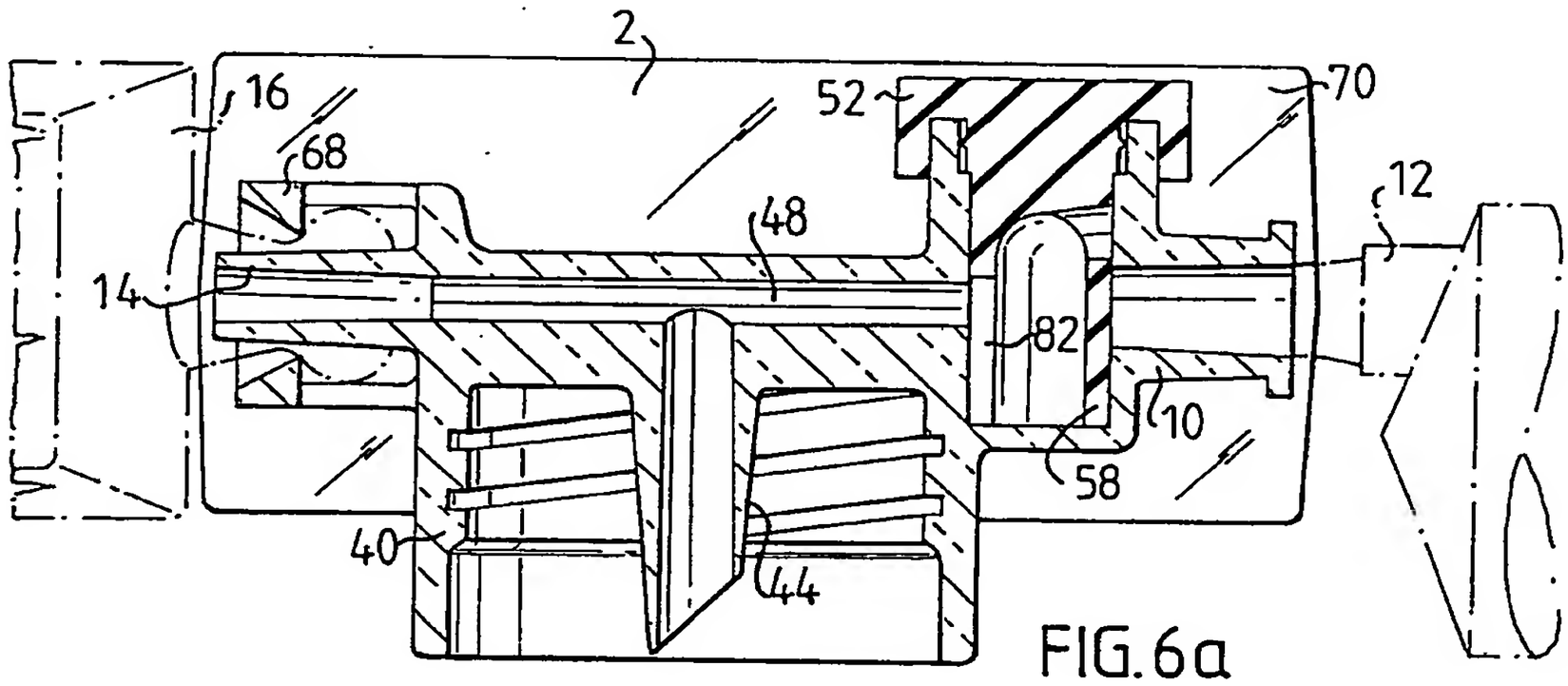


FIG.6a

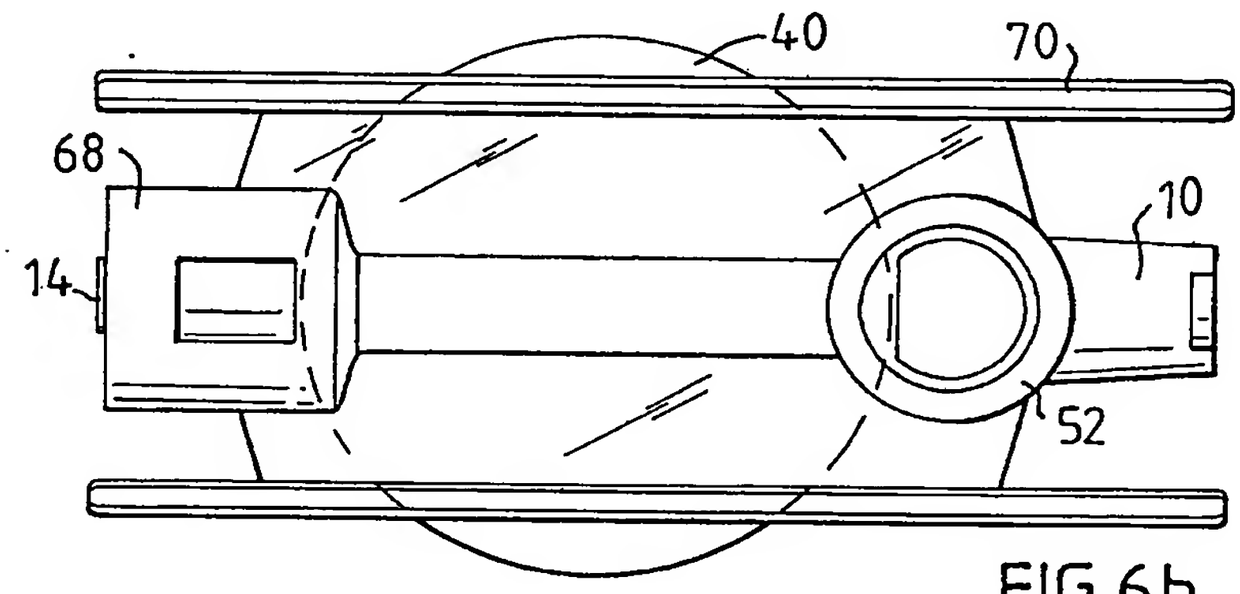


FIG.6b

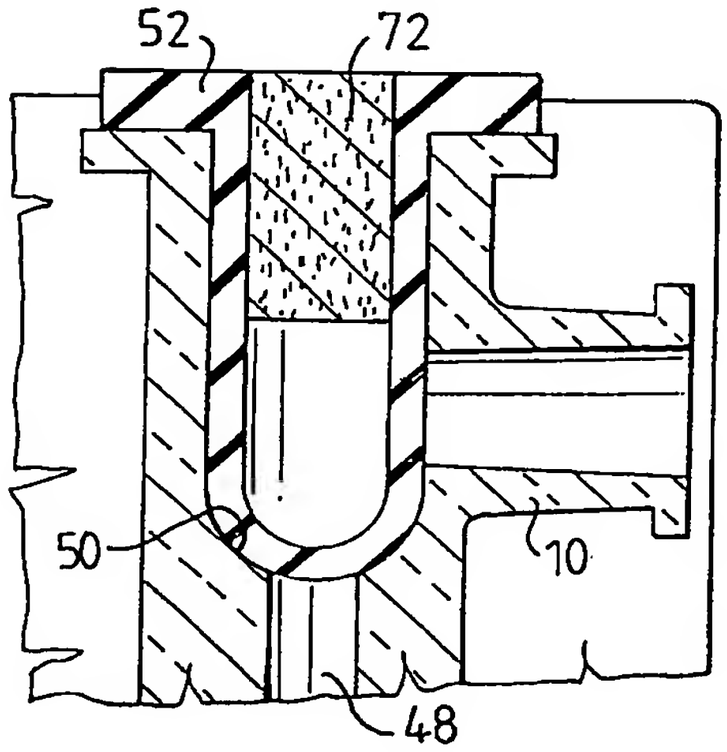


FIG.7

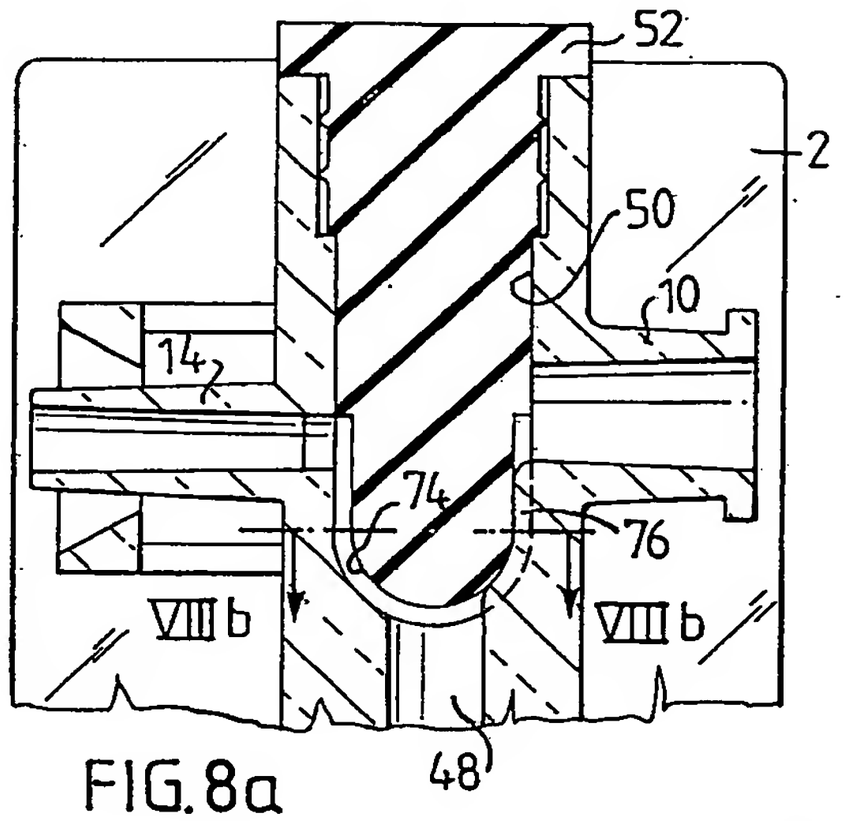


FIG.8a

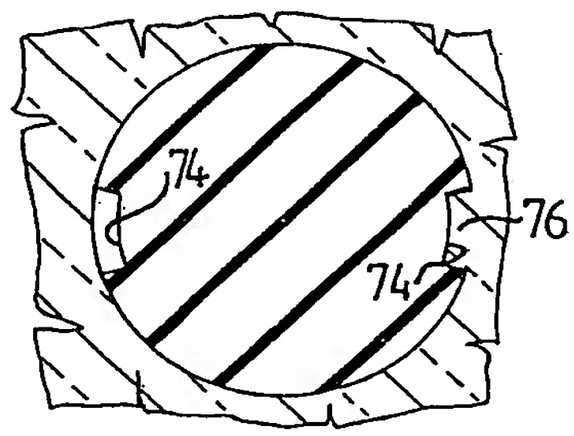


FIG.8b

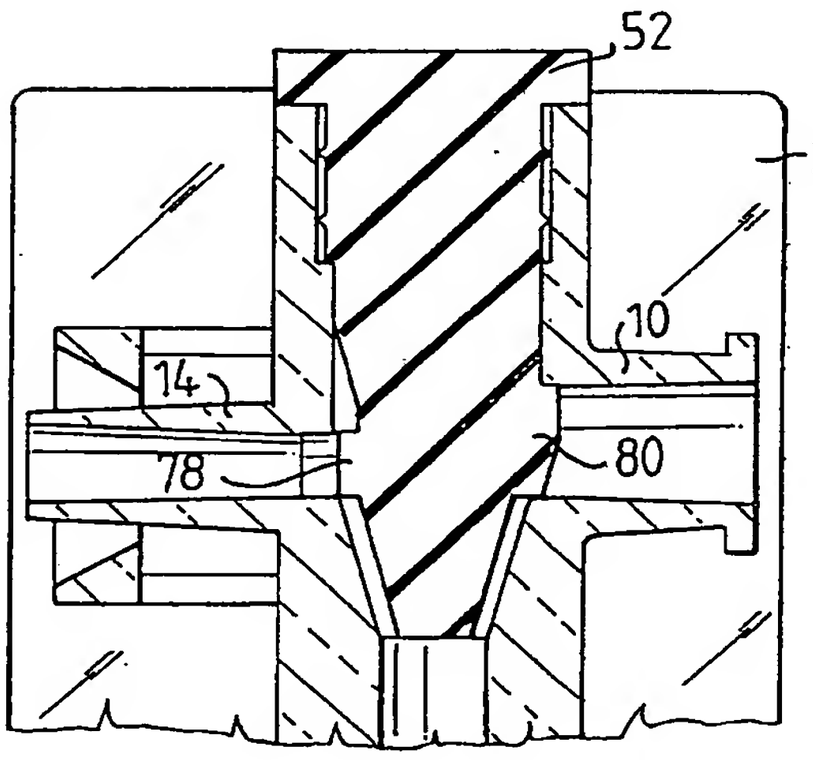
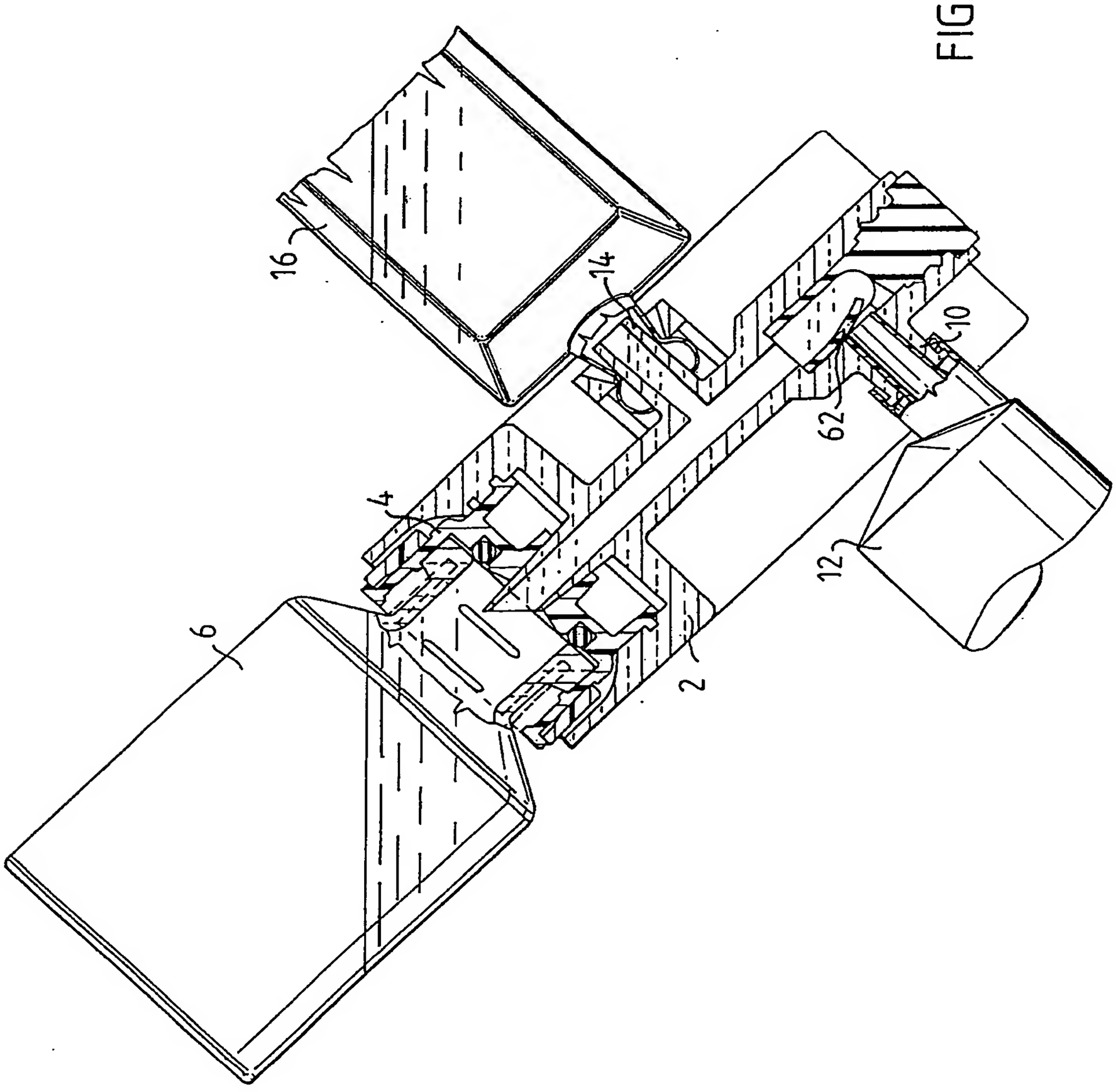


FIG.9

FIG 10



European Patent Office

EUROPEAN SEARCH REPORT

Application number
EP. 89850025.1

DOCUMENTS CONSIDERED TO BE RELEVANT

Category	Citation of document with indication, where appropriate, of relevant passages	Relevant to claim	CLASSIFICATION OF THE APPLICATION (Int Cl 4)
X	US-A-2 954 769 (JOHN CHARLES CALLAHAN ET AL) 4 October 1960 Column 2, line 28-58, fig 2 and 7	1	A 61 J 5/00
A	WO 83/00367 (WERNER TRAWÖGER) 3 February 1983 Page 3, line 13 - page 5, line 11, fig 1, claim 1	1	
A	SE-B-434 700 (BENGT GUSTAVSON) 13 August 1984 Page 3, fig 1-3	5,6	
A	NO-B-135 744 (DOLORGRAT ARZNEIMITTEL-FABRIK PETER DOLL KG) 6 August 1973 Page 3-5, fig 2	5,6	TECHNICAL FIELDS SEARCHED (Int. Cl.4) A 61 J

The present search report has been drawn up for all claims

Place of search	Date of completion of the search	Examiner
STOCKHOLM	20-03-1989	ÄNGGÅRD A

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